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EXAMINER

EDWARDS, PATRICK L

ART UNIT

PAPER NUMBER

2621

DATE MAILED: 01/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/803,802

Applicant(s)

CHEN ET AL.

Examiner

Patrick L Edwards

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 August 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 2 and 4-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20 is/are allowed.
- 6) ☒ Claim(s) 1, 2 and 4-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 August 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

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DETAILED ACTION

1. The response received on August 20, 2004 has been placed in the file and was considered by the examiner. An action on the merits follows.

Response to Arguments

2. The applicant's arguments, filed on August 20, 2004, have been fully considered. A response to these arguments is provided below.

Drawing and Specification Objections

Summary of Argument: Applicant has amended the specification and provided replacement drawing sheets to correct the previously objected to informalities.

Examiner's Response: The examiner appreciates the applicant's efforts to resolve these issues. The objections from the previous action are hereby withdrawn. However, a new specification objection will be provided below.

37 CFR 1.75 Claim Objections

Summary of Argument: Applicant has amended claim 19 to correct an improper claim dependency.

Examiner's Response: The previous objections under 37 CFR 1.75 are hereby withdrawn. The examiner appreciates the applicant's efforts to resolve this issue.

Prior Art Rejections

Summary of Argument: Applicant traverses the rejection in the prior office action of claims 1,2 4-9, and 14-19 under 35 USC 102e as being anticipated by Szeliski et al (USPN 6,044,181). Specifically, applicant argues that Szeliski fails to disclose that the images being merged together to form a panoramic image are not 'range images' as required by the claim.

Examiner's Response: Applicant's arguments have been fully considered and are persuasive. It appears as if the examiner misinterpreted the Szeliski reference by asserting that the overlapped images were range images. After taking a close look at the Szeliski reference, the examiner agrees that these images do not qualify as range images.

The previous claim rejections are therefore withdrawn, but the applicant's arguments regarding the prior art rejections from the previous action have been rendered moot by the new grounds of rejection provided below.

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Specification

3. The disclosure is objected to because of the following informalities:

The examiner requests that the applicant update the status of any US patent applications reference throughout the specification (e.g. 09/686,610 is now USPN 6,677,982).

Also, the applicant makes reference to USPN 4,953,616 in paragraph [0005] of the specification. This is obviously a typo, and should be changed to 4,935,616.

Also, the examiner suggests amending paragraph [0041] of the specification in order to more clearly identify the numbered elements. One non-exhaustive illustrative example is the sentence "A warping function and registration point is computed 110 and used to determine the differences in constant offsets of the relative 3D range values between image bundles from adjacent positions 112." This sentence is misleading because it appears that the '112' identifier is referring to 'adjacent positions.' The prior paragraph in conjunction with Figure 1 clearly show that identifier '112' refers to the step of 'determining relative range differences.' Thus, the language of paragraph [0041] is confusing and correction (this type of error occurs more than once in paragraph [0041]). Any other errors of this type that may exist in other paragraphs should be corrected as well.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 8 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Referring to claim 8, the metes and bounds of the term "elsewhere" are not clearly defined.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1 and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by R.T. Whitaker, J. Gregor, P.F. Chen, University of Tennessee (hereinafter 'renowned institution') with the paper, "Indoor Scene Reconstruction from Sets of Noisy Range Images". This paper was published in 1999 at IEEE's Second International Conference on 3-D Imaging and Modeling.

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With regard to claim 1, 'renowned institution' discloses a method for deriving a 3-D panorama from a plurality of images of a scene generated by a range imaging camera that produces ambiguities in range information (see the first paragraph of the 'Introduction': The reference describes deriving a 3-D model of an 'entire scene' (i.e. a panorama). The reference further describes that the images are 'laser range images' or 'LADAR data'. The applicant's disclosure (see paragraph [0027], *inter alia*) explains that the claimed range imaging camera that produces the range information is a laser radar. Thus, the reference clearly anticipates this limitation.

The 'renowned institution' further discloses acquiring a plurality of adjacent, overlapping range images (see Figure 4a-b).

The 'renowned institution' further discloses providing offset data for the range images (pg. 1 rt. col., final paragraph: The reference describes determining 'distances between views'. This is analogous to providing offset data as recited in the claim.) in order to recover corrected relative scene spatial information (pg. 1 right column, lines 4-7: The reference describes registering separate viewpoints and then integrating those viewpoints. This is analogous to recovering the relative scene spatial information. Furthermore, the great institution describes, in the second paragraph of the right column of page 2 of the reference, that a smoothing preprocessing operation is performed before all of the other processes. Smoothing qualifies as a type of 'correction'; therefore the reference also meets the claimed limitation of 'corrected relative scene spatial information.').

The 'renowned institution' further discloses detecting a relative range difference between adjacent range images as a constant offset (On page 1, right column, final paragraph, the reference describes determining a distance between views. The reference further elaborates on the view registration (or pose determination, see pg. 1, right column, the first two lines of the second paragraph) method and the plane offsets (see page 4 – rt. column – the paragraph between equations 9 and 10) by defining variables ω_1 and ω_2 , which are plane offsets. This clearly shows that we have a constant offset between adjacent range images as required by the claim.

The 'renowned institution' further discloses using this offset data to correct for ambiguities in the relative ranges of the range images, thereby providing corrected range images. As was stated in the paragraph above, the 'renowned institution' discloses determining range differences between adjacent range images. These offsets are analogous to the ambiguities recited in the claim (also see page 2 – left column – final paragraph: this passage makes explicit mention of the ambiguities associated with the range images). The passage cited in the above paragraph shows how the range differences are used in the determination of a translation which aligns, registers, or fits these images together, thereby providing corrected range images.

The 'renowned institution' further discloses deriving a 3D panorama from the corrected range images. This was discussed above with respect to the preamble. As was already stated, the 'entire scene' derived by the 'renowned institution's' reference, is analogous to the claimed 'panorama'. These two terms are definitionally equivalent (see websters dictionary).

With regard to claim 16, which merely adds a computer program for performing the steps of the method, this additional limitation is inherent in the 'renowned institution's' disclosure.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 2, 4, 5, 7, 8 and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of 'the 'renowned institution'' and Hsieh et al. (USPN 6,011,558). The arguments as to the relevance of the 'renowned institution' reference as applied above are incorporated herein and will not be repeated.

Referring to claim 2, the 'renowned institution' discloses that the scene spatial information is provided as image values in a local 3D coordinate system of each of the images (pg 2 – rt. column – 1st paragraph). the 'renowned institution' further discloses performing transformation calculations on a 3D grid (see pg. 7 – rt column – 1st paragraph). The examiner feels that a reasonably compelling argument could be made that the transformation to this 3D grid from the local 3D scanning coordinates is inherent in the system. However, the examiner agrees that this feature is not explicitly stated in the reference, and therefore will err on the side of caution and meet the limitation more convincingly with the teachings of Hsieh.

The Hsieh reference discloses transforming the image values from the local coordinate system of each image to a world coordinate system, thereby providing a transformed image (Hsieh col. 1 line 43 – col. 2 line 9 in conjunction with Figure 2: The reference discloses transforming the captured image plane's 10 coordinate system $P(x,y)$ to the cylindrical map coordinates $p(u,v)$. The cylindrical map coordinates are analogous to the world coordinate system recited in the claim. This coordinate transformation is performed for all of the captured image planes. Thus, the reference meets the plural claim language.

Hsieh further discloses warping a plurality of transformed images onto a cylindrical surface (Hsieh col. 2 lines 7-10); registering adjacent warped images (Hsieh col. 4 lines 33-35 in conjunction with figures 4a-b); and deriving the panorama using the warped images (Hsieh col. 2 lines 16-17).

It would have been obvious to one reasonably skilled in the art at the time of the invention to modify 'the renowned institutions' method of deriving a 3D panorama by transforming and mapping the captured image planes into a cylindrical shape as taught by Hsieh. Such a modification would have allowed for the building of a virtual environment map (Hsieh col. 1 lines 40-41).

Referring to claim 4, Hsieh further discloses that the images are acquired by horizontally rotating a camera about its optical center (Hsieh col. 1 lines 17-20). The only type of axis that a camera can be 'horizontally rotated about' is a vertical axis. Thus, the additional limitation of claim 4 is met by Hsieh. With regard to the claim 4 limitation of (X,Y,Z) coordinates and/or images, this limitation has already been addressed with respect to the claim

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2 limitation of a 3D coordinate and/or image. It is well known that (X,Y,Z) coordinates are merely a synonym for 3D coordinates. All of the 3D limitations were met by the 'renowned institution' reference.

Referring to claim 5, the limitations were addressed in the above claim 1 rejection.

Referring to claim 7: the world 3D coordinate system set forth in the prior art qualifies as an arbitrary 3D coordinate system. In fact, it is difficult to imagine a coordinate system that didn't qualify as 'arbitrary'. An arbitrary coordinate system is one with no limitations (see websters dictionary definition). Thus, by definition, it appears as if any 3D coordinate system would limitations of the claim. Furthermore, a 3D coordinate system is merely a collection of unit vectors used to determine the position of points in space. Since coordinate systems are an independent entity which establish a frame of reference, they themselves are not measured according to any outside frame of reference. Therefore, it could be said that all coordinate systems are arbitrary, since they are limited only to the discretion of an individual. As a result, we can conclude that the combination of the 'renowned institution' reference and the Hsieh reference meet the claimed limitations.

Referring to claim 8: this claim fails to further limit its parent claim. Any 3D world coordinate system will either be selected from the local 3D coordinate system, or a 3D coordinate system defined elsewhere. These are the only two possible options. As a result, the 3D coordinate system set forth in the prior art meets the limitations of the claim.

With regard to claims 14 and 15, which merely call for a system for performing the method of claims 1 and 4, Hsieh discloses such a system as can be seen in Fig. 6.

With regard to claims 16, 17, 18, which merely adds a computer program for performing the steps of the method of claims 1, 4, and 5. This additional limitation is inherent in the combination of the 'renowned institution' reference and Hsieh.

10. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of 'renowned institution' and Hsieh, and further in view of Ray (USPN 6,023,588). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

Referring to claim 6, the aforesaid combination discloses a range imaging camera for generating range images. The combination also discloses producing a 3D panorama. The combination fails to expressly disclose that the range images and the 3D panorama are in color. Ray, however, in the same field of endeavour, discloses using color images to produce a color 3D panorama (Ray col. 6 lines 16-20 and col. 8 line 11). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify the combination of 'renowned resolution' and Hsieh's method for producing a panoramic by merging range images by adding the element of color to the images as taught by Ray. Such a modification would have allowed for a more aesthetically pleasing and visually descriptive result.

11. Claims 9 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of 'renowned institution' and Hsieh as applied to claim 4 above, and further in view of Lipscomb et al. (USPN

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5,796,386). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

Referring to claim 9, the aforesaid combination discloses transforming the corrected relative spatial information, but fails to expressly disclose that the transformation comprises forming a homogenous transformation matrix. Lipscomb, however, discloses a transformation between coordinate systems which comprises forming a homogenous transformation matrix (Lipscomb col. 5 lines 56-63). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify Hsieh's coordinate transformation by utilizing a homogenous transformation matrix as taught by Lipscomb. Such a modification would have allowed for a computational friendly method of transforming between two coordinates, which could be easily programmed and executed on a computer.

12. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being obvious over the combination of 'renowned institution' and Hsieh as applied to claim 4 above and further in view of Ray et al. (U.S. Patent No. 6,118,946 B1). The arguments as to the relevance of Szeliski et al. in the rejection of claim 4 above are incorporated herein.

Szeliski et al. does not disclose that each image is captured as a bundle of associated images, nor does the reference disclose the particulars of such a bundle.

Ray et al., in the same field of endeavor of image processing and the same problem solving area of range image formation discloses capturing an image in such a manner and the particulars of such image capture.

In particular, as applied to claim 10, Ray et al. discloses that each image is captured as a bundle of associated images, said bundle including a plurality of phase images each incorporating the effect of a predetermined modulation frequency together with a phase offset unique for each image (see Fig. 3 and column 4, lines 38-55: The reference describes that each image is captured as a bundle of associated images and that the bundle includes at least three phase images each incorporating the effect of a predetermined modulating frequency and a phase offset.).

As applied to claim 11, Ray et al. discloses that each range image is generated from a respective plurality of phase images associated with each bundle (see column 4, line 42: The reference describes that the range image is generated from at least three phase images.).

It would have been obvious to one reasonably skilled in the art at the time of the invention the range image capture system described in the combination of 'renowned institution' and Hsieh by capturing a bundle of images to produce the range image as taught by Ray. Such a modification would have allowed for a resulting image with increased spatial resolution (Ray col. 1 49-51).

13. Claims 12 and 13 are rejected under 35 USC 103(a) as being obvious over the combination as applied to claim 10 above, and further in view of Ray (USPN 6,456,793). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

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As applied to claim 13, which is representative of claim 12, Ray et al. discloses that the bundle also includes a color image (see column 7, lines 46-48: The reference describes that the bundle includes a range image.).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Szeliski et al. by capturing each image as a bundle of associated images as taught by Ray et al. because such a system allows for the "capture [of] ranging information without the sacrificing color information that would otherwise be available for capture" (see Ray et al.: column 4, lines 11-13).

Therefore, it would have been obvious to combine Szeliski et al. with Ray et al. to obtain the invention as specified in claims 12-13.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.
- o Hall-Holt et al. (USPN 6,754,370) describes range scanning a moving scene
 - o Koffman et al. (USPN 6,542,249) describes many processing operations performed in the 3D range image environment.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patrick L Edwards whose telephone number is (703) 305-6301. The examiner can normally be reached on 8:30am - 5:00pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo Boudreau can be reached on (703) 305-4706. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

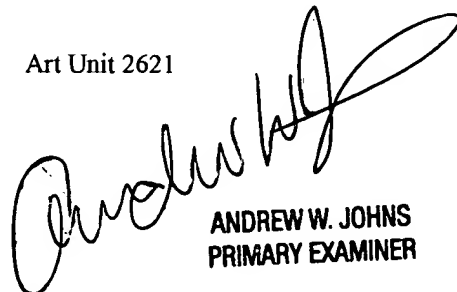
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Patrick L Edwards

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PRIMARY EXAMINER